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ACOUSTIC FACILITATION OF VISUAL DETECTION [1]

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11 Os were required to judge which of 4 temporal intervals contained a visual signal, in an experiment involving a total of 10,900 trials. Under some conditions, potentially useful time information was conveyed by accompanying sound stimulation, while it was lacking under others. Highest detectability of the signal was associated with an acoustic condition having white noise bursts coincident with each observation interval. Those detection scores were significantly superior to a "reciprocal" condition having the identical amount of acoustic time-specification information. Detection was poorest under continuous noise and silence, which were not discernably different in their effects. Simple time cueing was inferred not to provide an adequate explanation for the results.

An earlier forced-choice study (Watkins, 1964) found that detectability of a light signal increased when a recurrent pattern of noise bursts was substituted for continuous noise. The pattern responsible for this effect consisted of bursts coincident with the times of possible visual signal occurrence. The facility used did not permit inclusion of two sound conditions of potential interest: silence, and noise continuous except for silent periods coincident with observation intervals. In the absence of data regarding performance in silence, no appraisal of the absolute degree of facilitation accompanying introduction of noise was possible. More importantly, it was not possible to determine whether the increased detectability noted under the recurrent noise pattern was due simply to the provision of more precise cues to times of possible signal occurrence or to intrinsic properties of the pattern.

In the present experiment, interest centered upon the adequacy of observation-time-cueing as a basis for explaining differences in performance.

Meth d.—The *O* was required to judge which of four temporal observation intervals (OIs) contained a visual signal. He registered his decision by depressing one of four "vote" buttons, connected to a tape punch.

The apparatus used in this experiment is described elsewhere (Watkins, Nickerson, & Schjelderup, 1964). The elements were an observer station, control equipment, and a set of computer programs. Auditory and visual displays and a special *O*'s chair were contained within an anechoic chamber. The visual display panel was located 11 ft. in front of *O* and consisted of a transilluminated panel with attached time-cueing, "ready," and "vote" lamps. The brightness of the panel was 24 footlamberts (ftl.). A PDP-1 digital computer was used to generate signal sequences and to analyze data.

Figure 1 shows (I) the four OIs and (II) one trial sequence. The significance of "C" and "S" segments associated with four component periods of each trial was as follows: C: The segment during which a $2\frac{1}{2} \times 3\frac{1}{2}$ in. cue panel, at lower left corner of the main display area, bearing the letter L, was lighted. S: The segment during which the signal could have been presented—i.e., an OI.

A signal consisted of an increase of the order of 4% in the brightness of a 1.3-in. fixation spot (circular, 25-ftl. patch) in the center of the display panel. It was produced by raising the current flow through a projector lamp by a given amount (determined by signal strength needs) for 165 msec.

Four independent blocks of 12 trials comprised a run of 48 successive trials. Signals were distributed among the four OIs such that each block included three occurrences of the signal in each OI. For any *O*, a run sequence was used only once.

Four men served as the first sample of *O*s; seven women as the second. All were naive concerning the purposes of the investigation. After brief practice, each *O* on the first

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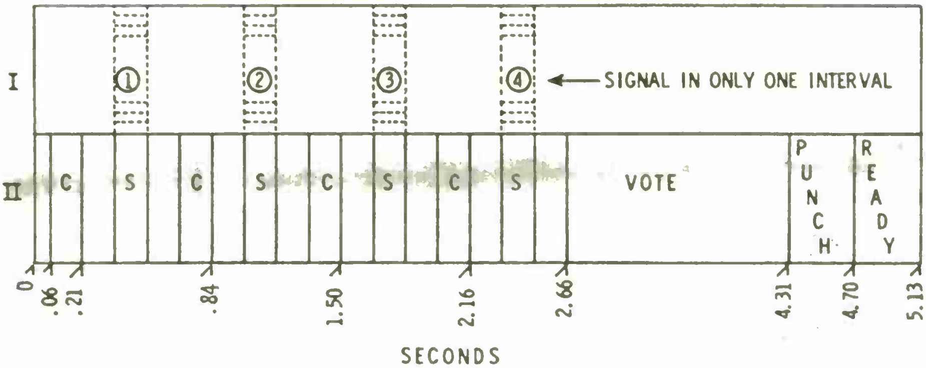

FIG. 1. Standard time configuration of trials. (I: Four possible signal intervals. II. Basic time periods. Between the .06- and 2.66-sec. points, there were 16 equal segments of approximately 165 msec.)

sample performed eight sets of four runs with each set consisting of one run under each of four acoustic conditions. The duration of each run was 4 min.; a rest period followed. Acoustic conditions used were (Cond. 1) continuous noise; (Cond. 2) noise continuous except for interruptions coincident with observation intervals; (Cond. 3) silence except for noise bursts coincident with observation intervals; and (Cond. 4) silence.

Since silence had proved essentially equivalent to continuous noise for the first sample (see results), *E*s elected to terminate "silent" testing at this point, in the interest of collecting more data under conditions of greater concern. Accordingly, the second sample was tested under Cond. 1, 2, and 3 only. After practice, these *O*s accomplished a total of 33 sets (i.e., 99 runs). The noise (presented through earphones) had a frequency range of 100–6800 cps and a sound pressure level (SPL) of 70 db. overall. Knowledge of results was provided in the form of numbers of trials correct at the end of each run.

Results.—For the first sample, group means (percentage of correct trials) were: Bursts at OIs: 46.6; Interruptions at OIs: 43.8; Continuous noise: 40.6; Silence: 40.0. For each of the *O*s, Bursts at OIs was the condition showing highest detection rate. That condition was significantly superior to the other intermittent noise condition: $F(1, 3) = 13.5$, $p < .05$. The data of the second sample yielded means of 62.3 (Bursts), 56.4 (Interruptions), and 49.3 (Continuous noise). The t tests comparing these (correlated) means revealed that all conditions differed from the others significantly ($p < .01$).

Discussion.—The evidence provided by the first sample showed that continuous presentation of the moderate level of noise chosen did not establish a state of elevated or depressed visual sensitivity.

Time-cueing alone appeared inadequate as a mechanism to account for the superior detectability of visual signals found when OIs were accompanied by noise bursts. If bursts had served simply to mark the boundaries of OIs, thus informing *O* as to when he should watch for a signal, then the reciprocal condition—interruptions at OIs—should have served as well. The latter condition was inferior to the bursts condition but better than continuous noise. Since OI-phased noise presentation, even of the "interruptions" variety, did aid visual detection, the provision of increased time certainty may not be rejected as a partial explanation. Additional relevant studies (Watkins & Feehrer, 1964) corroborate these conclusions. However, the precise role of noise bursts in this type of task remains unknown.

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